REMARKS

Claims 1-22 and 24-43 are pending in the application. Claim 23 was previously canceled. Claims 1, 2, 9, 10, 19, and 24 are the only independent claims.

Interview Applicants wish to thank the Examiner for the courtesy of the telephone interview of November 29, 2005. During that interview, applicant Tim Nohara provided the Examiner with background information, including the reasons for the development of the invention, and discussed the differences between the invention and the prior art relied on by the Examiner in the Office Action of September 15, 2005. The substance of those distinctions is presented below. During the discussion, the Examiner indicated that claims 1 and 9 might be allowable if amended to clarify how the extractor and the extraction process use the output of the detector and the results of the detection operation. Claims 1 and 9 have been so amended herein.

Claims Rejections - 35 U.S.C. §§ 102 and 103

Claims 1-3, 8-11, 16, 18, and 41-43 stand rejected under 35 U.S.C. § 102(b) as being anticipated by U.S. Patent No.4,933,954 to Petry.

Claims 19, 20, 24, 25, 30, and 31 stand rejected under 35 U.S.C. § 102(b) as being anticipated by U.S. Patent No. 5,412,690 to Kotzin et al. ("Kotzin").

Claims 5, 6, 13, and 14 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Petry in view of Kotzin.

Claims 26 and 27 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Kotzin.

Claims 34 and 36 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Kotzin in view of Petry.

The Examiner has indicated that claims 4, 7, 12, 15, 17, 21, 22, 28, 29, 32, 33, and 37-40 would be allowable if rewritten in independent form to include all of the limitations of the base claim and any intervening claims.

Claim 1 In response to the rejection of claim 1 under 35 U.S.C. § 102(b) as being anticipated by Petry, applicants have again amended claim 1 herein to provide a better definition of the invention. Applicants respectfully maintain that claim 1 distinguishes the invention over the prior art and particularly over the art relied on by the Examiner in rejecting the claims of the instant application.

Pursuant to the present invention as set forth in amended claim 1, a signal intercept and analysis processor for a wideband intercept receiver system including at least one wideband signal receiver comprises a signal detector operatively connectable to the wideband receiver, wherein the detector is configured for automatically detecting the existence of multiple signals simultaneously present in the wideband receiver and estimating respective time and frequency extents of the detected signals. The processor further comprises a signal extractor operatively connected to the signal detector and connectable to the wideband receiver for performing signal extraction directly on a wideband signal output of the receiver and for performing the signal extraction on one or more of the detected signals using the respective time and frequency extents.

Petry does not disclose or suggest such a signal intercept and analysis processor. More particularly, Petry neither discloses nor suggests a signal intercept and analysis processor having a detector configured for automatically detecting the existence of multiple signals simultaneously present in the wideband receiver and estimating respective time and frequency extents of the detected signals. The signal extractor of applicants' intercept and

analysis processor performs signal extraction on one or more of the detected signals using the respective time and frequency extents.

While Petry discloses "a signal detector" in Figure 1 element 6, Petry's detector is different from and extremely limited as compared to the signal detector of amended claim 1. The detector of claim 1 "is configured for automatically detecting the existence of a plurality of signals received simultaneously present in the wideband receiver". Petry's detector is not and cannot be so configured. Furthermore, Petry's Intercept Receiver (element 10) can only tune to a ***single*** narrowband frequency ***at a time*** to receive the message signal of a single frequency hopping transmitter. Applicants teach novel ways to design and build a detector (element 4 in applicants' Figure 1) (and extractor, element 5 in Figure 1) capable of detecting the existence of a plurality of simultaneously transmitting frequency hopping emitter signals (see for example Figure 1 and 2 elements 3 and 4, pg.2 lines 5-10, pg.6 line 28 to pg.7 line 16, pg.12 lines 28-29 and pg.13 lines 1-2 and lines 11-14, pg.14 lines 18-20, pg.15 lines 22-30, pg.16 lines 2-9, pg.18 lines 8-12, pg.19 lines 15-24, pg.24 line 25 to pg.25 line 29, pg.26 line 5 to pg.27 line 3, pg.27 line 19 to pg.28 line 17, pg.30 line 3 to pg.32 line 4) and of extracting all of the emitter signals. Petry does not. Applicants' detector automatically detects the existence of the plurality of signals present in the wideband input (such as frequency hopping signals or single channel signals) and estimates their respective time and frequency extents. This information is used by the extractor to efficiently extract these signals simultaneously from the wideband input.

In fact, Petry provides no teaching on how his detector (Figure 1, element 6) works, except that one skilled in the art can conclude from col. 3 lines 1-25, that the detector (6) which is part of his FFT search receiver (2) *"determines in a known way within a*

predetermined time window the instantaneous frequency ... occupied by the frequency hopping transmitter, i.e. it determines ... the frequency position which the frequency hopping transmitter had at a predetermined system cycle time". Petry is silent on the issue of multiple frequency hopping signals of interest present in the input wideband signal. <u>His entire invention relates to the reception of the message signal from a single frequency hopping transmitter.</u> If there are two or more frequency hopping transmitter signals of interest present, Petry's device may not be able to intercept even one of them. The presence of two signals of interest could cause the Petry device to fail altogether. The ability of Petry's invention to continue to intercept one of the signals of interest in the presence of a second is unclear as he provides no teaching to enable one skilled in the art to answer this question. Many methods for detection known to those skilled in the art require knowledge of the number of simultaneously transmitting signals, which is unknown for intercept receivers.

The Examiner is correct to point out that in practice, "it is inherent that there's present a plurality of signals received by the receiver since signals over the air space would include, among other signals, at least interference signals." This fact is an issue that designers must deal with, notwithstanding the fact that Petry is completely silent on this issue. Applicants, on the other hand, do teach how to intercept robustly in the presence of interference (see, for example, pg. 30, lines 1-30 of applicants' disclosure). However, this issue of interference is altogether different from the issue of being able to intercept (i.e., detect and extract) two or more simultaneous frequency hopping signals of interest, which is a unique and key feature of the present invention.

Unlike Petry, applicants' invention supports the simultaneous recombining of respective messages from multiple, simultaneously transmitting frequency hoppers and single

channel transmitters, and applicants teach how to do so robustly (see, for example, pg. 30, lines 1-30). Applicants' invention not only simultaneously detects any and all frequency hopping signals of interest simultaneously present in the input wideband signal (which also contains interference), but on detection of such signals of interest, it can extract all of those respective signals as well.

Claim 2 Applicants respectfully disagree with the Examiner about the patentability of claim 2 and maintan that claim 2 distinguishes applicants' invention over the prior art as represented by the Petry reference. Petry does not teach or suggest "a signal detector ... wherein said signal detector includes means for generating a time-frequency representation of said wideband signal output". Rather, Petry teaches the use of an FFT search receiver that determines the instantaneous frequency occupied at a particular time (predetermined time window). Petry's use of an FFT is one-dimensional (i.e., frequency only, measured at a particular time; the FFT output can be drawn as a line graph) (see col. 4, lines 1 to 16). Applicants' use of a time-frequency representation is two-dimensional (time and frequency; i.e., it requires a plane on which to represent the information) and has several performance benefits as a result. See, for example, pg. 17, line 28, to pg. 18, line 14, and pg. 26, line 1, to pg. 28, line 30. Applicants' invention provides a preferred means for detecting the presence of a plurality of signals and estimating their respective time and frequency extents.

Claim 3 Applicants respectfully traverse the Examiner's rejection of claim 3 and observe that Petry does not teach or suggest the use of a time-frequency representation (please see applicants' discussion of claim 2 above) and nor does he teach "a means for generating a coarsely sampled or decimated time-frequency representation". Petry's FFT is one-dimensional and starts over each *"system cycle time"*. Using Petry's definitions of

timing, applicants' detector operates over many of Petry's system cycle times and employs coarse or decimated time 2D representation which is novel. Applicants' detector is therefore able to delineate precisely the starting and ending times of each frequency hop (i.e., the signal from a frequency hopping transmitter associated with a particular transmission at one particular frequency) (see, for example, pg. 30, lines 3 to 8). These times (endpoints) are then used for precise extraction of the frequency hopping signal (element 5 in our Figure 1). Petry's FFT search receiver (element 2 in Petry's Figure 1), which does not employ a coarse 2D time-frequency representation requires an additional detector (see signal detector element 16 in Petry's Intercept Receiver shown in Figure 2) and additional complex logic (see element 17 in Petry's Figure 2, and its behavior as illustrated in Figure 3 and as described in col. 4, line 31. to col. 6, line 13) in order to determine when in time the frequency hopping signal changes from one narrowband frequency to the next. All of Petry's complexity is necessary for intercepting (i.e., detecting and extracting) a single frequency hopping signal. Applicants' approach works for any number of simultaneously present frequency hopping signals of interest.

<u>**Claim 9**</u> In response to the rejection of claim 9 under 35 U.S.C. § 102(b) as being anticipated by Petry, applicants have again amended claim 9 herein to provide a better definition of the invention. Applicants respectfully maintain that claim 9 distinguishes the invention over the prior art and particularly over the art relied on by the Examiner in rejecting the claims of the instant application.

As set forth in amended claim 9, a signal intercept method for a wideband intercept receiver system comprises analyzing a wideband signal output of a wideband receiver to detect the existence of a plurality of signals simultaneously present in the wideband signal

output and to estimate respective time and frequency extents of the detected signals. The method further comprises, upon detecting the presence of multiple signals simultaneously present in the wideband signal output, extracting at least one of the multiple signals directly from the wideband signal output using the respective estimated time and frequency extent.

Again, Petry neither discloses nor suggests analyzing a wideband signal output of a wideband receiver to detect the existence of a plurality of signals simultaneously present in the wideband signal output and to estimate respective time and frequency extents of the detected signals. Petry neither discloses nor suggests extracting at least one of the multiple signals directly from the wideband signal output using the respective estimated time and frequency extent.

Applicants request that the Examiner, when reconsidering the patentability of claim 9, also consider applicant's comments with reference to claim 1 above.

Claim 10 Applicants respectfully traverse the rejection of claim 10 for the reasons set forth above with respect to claim 2.

Petry does not disclose or teach generating a time-frequency representation of the wideband signal output. Pursuant to claim 10, applicants estimate signal strength as a function of two variables, time and frequency. In contrast, Petry's method determines signal strength or amplitude solely as a function of one variable, the frequency. There is nothing whatsoever in the teachings of Petry that would motivate or suggest to one of ordinary skill in the art to detect signal strength or amplitude as a function of two variables, namely, time and frequency.

Petry teaches the use of an FFT search receiver that determines the instantaneous frequency occupied at a particular time (predetermined time window). Petry's use of an FFT

is one-dimensional (frequency only). As set forth in claims 2 and 10, applicants' use of a time-frequency representation is two-dimensional (time and frequency) and has several performance benefits as a result. Therefore, claims 2 and 10, as well as the claims dependent therefrom, are allowable over the prior art and particularly over Petry.

Claim 11 Applicants respectfully contravene the Examiner's rejection of claim 11, essentially for the reasons discussed above with respect to claim 3.

Claim 18 Applicants respectfully disagree with the Examiner as to the patentability of claim 18.

Claim 18 has been amended to accord with the amendments made herein to claim 9, from which claim 18 depends. Pursuant to amended claim 18, the signal intercept method of claim 9 further comprises extracting all of the detected signals directly from the wideband signal output upon detecting the signals in said wideband signal output, the extracting of the detected signals including using the respective estimated time and frequency extents.

Applicants request that the Examiner consider applicants' comments with reference to claim 9 above. Furthermore, for the case where multiple signals of interest are simultaneously present in the wideband input signal, this claim relates to the detection of all of these signals and the extraction of all of these signals. Petry teaches neither of these and his invention cannot extract more than one signal of interest. Petry's intercept receiver can only tune to a single hop frequency at a time. The output of element 14 in Petry's Figure 2 represents the instantaneous heterodyne frequency that tunes the Intercept Receiver to receive a particular frequency hopping signal (see col. 4, lines 37-42).

Claims 19 and 24 Applicants respectfully traverse the Examiner's rejection of claims 19 and 24. Both of these claims are novel over Kotzin and should be allowed as is.

As set forth in claim 19, a signal intercept and analysis processor for a wideband intercept receiver system comprises a digital filter bank generating a coarsely sampled or decimated time-frequency representation of a wideband signal output of a wideband receiver of the wideband intercept receiver system, the time-frequency representation being coarsely sampled or decimated in a time domain and fully represented in a frequency domain. A signal detection component is operatively connected to the digital filter bank for analyzing the time-frequency representation to detect presence of at least one unknown signal.

Kotzin relates to receiver design for known, cooperative communication signals (i.e. the transmitter and receiver are cooperating to communicate) and is not really relevant prior art. The Examiner has evidently misinterpreted Kotzin et al. (US 5,412,690) due to terminology used by Kotzin et al. but with very different meanings from those used as to applicants' intercept receivers. The confusing words are "detect" and "intercept" (along with variations thereon).

Kotzin's invention relates to a "flexible receiver architecture [that] would, for example, be ideally suited for cellular radio communication systems. … If cellular operators were to use current receiver design techniques, then a new receiver would have to be designed and built for each new information signal coding and channelization standard. … Some of these coding and channelization approved and proposed standards [include] … AMPS, … GSM, … Frequency Hopping Spread Spectrum (FH-SS), … Cordless Telephone 2 …" (col. 2 line 54 to col 3 line 25). Such receivers require complete knowledge of the transmitted signals of interest to decode or receive the information. The knowledge of the

signal structure (e.g., the hop sequence that a frequency hopping transmitter employs) is embodied in standards and built into the design of the receiver. Such receiver designs are completely different from an intercept receiver (which is the subject of applicants' invention) as described below.

When Kotzin et al. speak of "intercepted electromagnetic radiation" (e.g., col. 1, line 13), they are referring to the known communication signals "received" by the receiver (through its antenna) that were transmitted by the authorized users of the communications system (see also element 400 in Figure 9). When Kotzin et al. speak of "a detector ... which detects an information signal" (col.6 lines 56-58), they mean demodulating the message signal to extract the message content from the underlying signal of known coding and channelization.

On the other hand, in applicants' invention, an intercept receiver or interceptor is a receiver that does not know whether signals of interest are even present, and if they are, does not know their signal characteristics (e.g. pg.1 lines 20 to 30); such a receiver needs to figure this out by analyzing the received wideband signal. When applicants use the term "detect" or "detector", applicants mean the method or device (e.g. element 4 in Figure 1) that analyzes the wideband signal, determines how many signals of interest are present in the wideband signal, and then estimates various parameters such as the frequencies and bandwidths of each of the detected signals and their extent in time. These detection data (1st level parameters) are then used by a signal extractor (element 5) to extract the sequence of baseband signal samples associated with each detected signal. These elements (4 and 5 in Figure 1) are absent from Kotzin's communications receiver (because it already knows the data they provide). On the other hand, assembling the baseband signal samples associated with the

extracted signals and extracting the message content (element 410 in Figure 9 of Kotzin) are absent from applicants' invention. Indeed, applicants could employ demodulation techniques known to those skilled in the art to extract the message content, but novel ways of doing this are beyond the scope of the present invention.

Kotzin et al. use a digital filter bank as part of their invention that is contained in element 104 of Figure 1 and "which digitizes a portion of the electrical signal 300 into a plurality of digitized signals 112, 113, and 114. As shown in Figure 7, the electrical signal 300 is divided, by the digitizing device 104, into a number of portions with a corresponding number of bandpass filters (e.g. ... 302, 304, 306 ...) [col 6 lines 10-16]" (see Figure 7). <u>The digital filter bank operates at the Nyquist rate (see for example col.7 line 8 to 10) and the bandpass filter output must also be represented at the Nyquist rate</u> (based on the underlying signal bandwidth) in order to preserve the information content of the signal through the Digital Combiner 116 and the Detector 120 in Figure 1, which leads to the output Information Signal 122.

Kotzin's use of a digital filter bank operating at the Nyquist rate is conventional and is well described in the literature. However, <u>applicants' use of a time-frequency representation (the output of a digital filter bank could be utilized as a time-frequency representation) coarsely sampled or decimated in time (compared to Nyquist) is novel and goes against conventional wisdom (see for example pg. 15 line 21 to pg. 16 line 10). Kotzin et al. do *not* teach coarsely sampled time-frequency representations and their invention would fail if they replaced their digital filter bank with a coarsely sampled digital filter bank</u>.

<u>Claim 25</u> Applicants respectfully traverse the Examiner's rejection of claim 25. Kotzin et al. do not teach or disclose "estimating and outputting coarse end points and a

center frequency for each detected signal" as claimed. Kotzin's receiver knows the time durations, frequency durations (or bandwidths) and center frequencies of the signals Kotzin wishes to receive because they conform to a standard that Kotzin's receiver has been configured for. Kotzin's receiver does not need to detect and estimate as an intercept receiver such as ours needs to (please see the earlier discussion above). In col.7, lines 21-38, Kotzin is describing how to <u>reconfigure</u> a 30 MHz receiver built in accordance with his invention for a new standard, namely, reception of two 5 MHz band signals separated by over 10 MHz of spectrum. The reconfiguring is done by the communications system operator in advance of using this new standard. Once configured through reprogramming of the receiver, the system is ready to go and it does ***not*** estimate signal characteristics (e.g. our coarse end points and center frequency) on the fly as it already knows them. The idea of reconfiguring or reprogramming the receiver in response to a new communications signaling scheme (i.e. code or standard) is further described in Kotzin et al., col. 8, lines 3 to 16).

<u>Claim 30</u> Applicants disagree with the Examiner as to the patentability of claim 30. Kotzin et al. do not disclose "operating a coarse digital filter bank" and nor would their invention work if they used one. Please see our response to claim 19 and 24 above for details.

<u>Claims 34 and 36</u> Applicants respectfully disagree with the Examiner. Petry's use of the wideband signal and that of Kotzin et al. are incompatible. Petry deliberately digitizes the wideband signal at Nyquist so that it can be stored in a digital memory (FIFO) and so frequency hopping signal of interest can be received by Petry's Intercept Receiver. Kotzin et al., on the other hand, do ***not*** want to digitize the wideband signal because it implies numerous technical challenges and costs (see col. 2, lines 7 to 54). Kotzin's entire approach

is centered around using narrowband digitization based on the bandwidth of a signal of interest rather than of the receiver front-end bandwidth. Kotzin's use of a digital filter bank is directed towards bandpass filters (that may be implemented using FFTs) rather than a digital, time-frequency representation of the entire receiver bandwidth.

Claim 43 Applicants respectfully disagree with the Examiner as to the patentability of claim 43.

Claim 43 delimits the subjects matter of claim 10 and sets forth that the one signal of claim 10 is one of a plurality of signals present in the wideband signal output and that the analyzing of the wideband signal output includes detecting all the signals in the wideband signal output. Pursuant to claim 43, the method of claim 10 further comprises extracting the signals directly from the wideband signal output upon detecting the presence of the signals in the wideband signal output.

Claim 43 is patentable for the reasons discussed above with respect to claim 10. Furthermore, applicants request that the Examiner reconsider the patentability of claim 43 with reference to applicants' discussion of claim 1 above. In the method of Petry, not every signal of interest is detected. At best, only one of them is detected. For the case where multiple signals of interest are simultaneously present in the wideband input signal, claim 43 relates to the detection of all of these signals <u>and the extraction of all of these signals</u>. Petry teaches neither of these and his invention cannot extract more than one signal of interest. Petry's intercept receiver can only tune to a single hop frequency at a time. The output of element 14 in Petry's Figure 2 represents the instantaneous heterodyne frequency that tunes the Intercept Receiver to receive a particular frequency hopping signal (see col. 4, lines 37-42).

Conclusion

For the foregoing reasons, independent claims 1, 2, 9, 10, 19, and 24, as well as the claims dependent therefrom, are deemed to be in condition for allowance. An early Notice to that effect is earnestly solicited.

Should the Examiner believe that direct contact with applicant's attorney would advance the prosecution of this application, the Examiner is invited to telephone the undersigned at the number below.

Respectfully submitted,

COLEMAN SUDOL SAPONE, P.C.

By: R. Neil Sudol

R. Neil Sudol
Reg. No. 31,669

714 Colorado Avenue
Bridgeport, CT 06605-1601
(203) 366-3560

Dated: December 14, 2005